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AUTONOMOUS AERIAL SENSORS FOR WIND POWER METEOROLOGY - LESSONS LEARNT

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Introduction

This paper describes a new approach for measurements in wind power meteorology using small unmanned flying platforms. Large-scale wind farms, especially offshore, need an optimisation between installed wind power density and the losses in the wind farm due to wake effects between the turbines. Good measurements of the wake and wake structure are not easy to come by, especially offshore. Very few measurement masts exist to verify our knowledge of atmospheric physics, and most of them are situated in quite homogeneous and gentle terrain. Here, automated Unmanned Aerial Vehicles (UAVs) could be used as either an extension of current masts or to build a network of very high 'masts' in a region of complex terrain or coastal flow conditions.

Approach

In order to test the potential and limits of UAVs for wind power meteorology, this project assembles four different UAVs from four participating groups. Risø has built a lighter-than-air kite with a long tether and nano-synchronised sensors, Bergen University flies the SUMO, a pusher airplane of 580g total weight equipped with a 100Hz Pitot tube, Tübingen University in conjunction with the TU Braunschweig flies the Carolo, a 2m wide two prop model with a 5-hole pitot tube on the nose, and Aalborg University will use a helicopter with a sonic anemometer as a slung load.

Main body of abstract

Conclusion

It was planned to fly all those platforms during one week at the Danish national test station for large wind turbines at Høvsøre. One of the large lessons learnt was that permitting is a major concern - both the campaign at Høvsøre and the alternate location at Risø had to be cancelled for different reasons, both related to flying permits. There was one week of flying though at the Nøjsomheds Odde wind farm in Lolland, where we could compare the SUMO and balloon with a Lidar and data from the wind farm. The other platforms performed their tests separately. Lastly, the lessons learnt were used to do a detailed planning for a possible offshore campaign.